(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 May 2001 (03.05.2001)

PCT

(10) International Publication Number
WO 01/31952 A1

(51) International Patent Classification[7]: H04Q 7/32

(21) International Application Number: PCT/FI00/00927

(22) International Filing Date: 26 October 2000 (26.10.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
19992325 28 October 1999 (28.10.1999) FI

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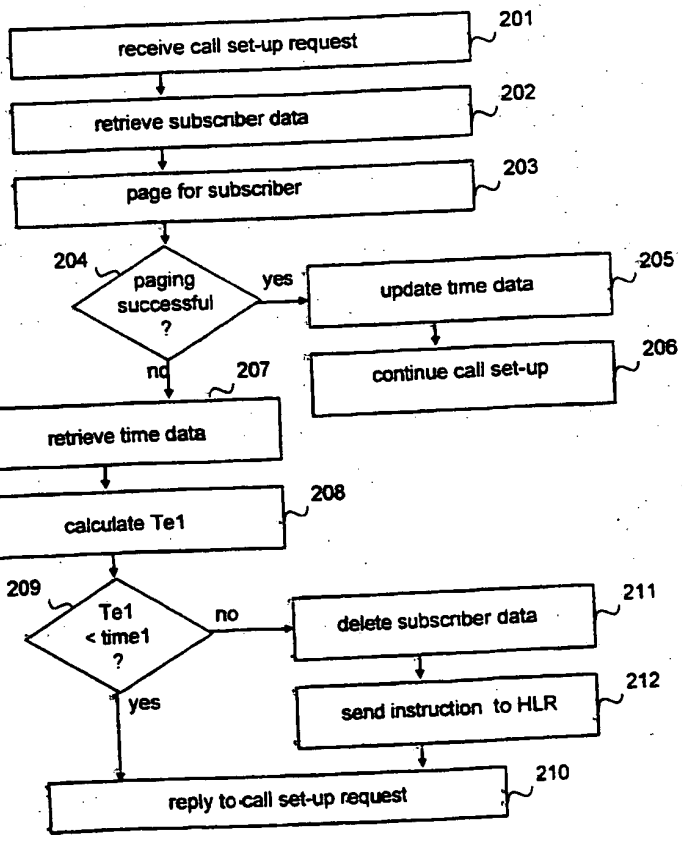
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,

[Continued on next page]

(54) Title: A METHOD OF DELETING SUBSCRIBER DATA OF AN INACTIVE MOBILE STATION FROM A SYSTEM DATABASE



(57) Abstract: A method, a system and a network node for deleting the subscriber data of an inactive mobile station from a mobile system database containing temporary subscriber data on the subscriber using the mobile station such that the network is not loaded by the activity check. For this purpose, the system maintains (205) time data indicating the last contact with a mobile station over the radio path. When a mobile station is paged (203) to verify the activity of the mobile station triggered by a factor unrelated to checking the activity of a mobile station of the mobile system, and the mobile station does not answer the paging, a first inactivity time, which is the time between the time data and the paging time, is calculated (208); a check is made (209) to see if the first inactivity time is equal to or longer than a predetermined time limit; and, if so, the subscriber data is deleted (211) from the database.

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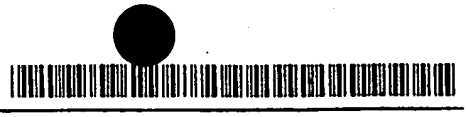


IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— *With international search report.*

— *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A METHOD OF DELETING SUBSCRIBER DATA OF AN INACTIVE MOBILE STATION FROM A SYSTEM DATABASE

BACKGROUND OF THE INVENTION

The invention relates to detecting inactive subscribers, and particularly to detecting visiting subscribers and deleting their subscriber data from a visitor location register.

Mobile systems have been developed to allow people to move away from fixed telephone terminals without complicating their accessibility. Cellular type of mobile systems are thus characterized in that subscribers can move freely with their mobile stations and connect from one cell to another within the area of the system. To manage subscriber mobility and to obtain necessary subscriber data sufficiently rapidly for the use of the exchange serving a subscriber's mobile station, various databases, called subscriber data registers, are maintained in mobile systems. In a home location register, subscriber data on all subscribers in the network is stored permanently or semi-permanently. The home location register also usually contains routing information and information indicating whether or not the subscriber is active. The mobile station of an active subscriber is registered in the network and is able to initiate and receive calls. A visitor location register is another type of database containing temporary subscriber data. A visitor location register is usually associated with one mobile telephone exchange, but it may also serve several exchanges. When a subscriber is active, the majority of the subscriber data concerning the subscriber and contained in the home location register is loaded (copied) to the visitor location register of the mobile telephone exchange within the area of which the mobile station used by the subscriber is located. Correspondingly, the address of the visitor location register is stored in the home location register, in the subscriber's routing information. When a subscriber (and the mobile station) moves and at the same time proceeds from the area of visitor location register one to the area of visitor location register two, the address of visitor location register two is stored in the home location register as the address of the subscriber, and the subscriber data is deleted from visitor location register one. Correspondingly, when the subscriber's mobile station unregisters from the network, the subscriber data is deleted from the visitor location register and the subscriber is marked in the home location register as unreachable.

The problem in the above arrangement is that a subscriber's mobile

station is able to leave the coverage area of a mobile system without unregistering. This usually happens when the connection to the system is suddenly lost, for example when the mobile station enters a shadow area. In this case the subscriber becomes an inactive subscriber (mobile station), which in the present application refers to a subscriber (mobile station) that is not accessible to the system, but whose data remain in the database of a visitor location register because of a previous registration, for example crossover, i.e. location update, or registration to the network. The subscriber data remained in a home or visitor location register unnecessarily uses up scarce radio path resources, and delays are caused in call forwarding as unnecessary attempts are made to reach the subscriber for calls. Furthermore, superfluous subscriber data consume the database capacity of a visitor location register.

A solution to the problem is for the system to maintain information on the last contact between the system and a subscriber (mobile station) over the radio path, and to delete the subscriber's data from the visitor location register when no contact with the subscriber (mobile station) is detected during a given time, for example two days. The problem in this solution is that, in addition to data on inactive subscribers, data on valid subscribers is also deleted. A valid subscriber is a subscriber who is able to and wants to be registered in the system, but has for example not moved or made or received calls during said given time. If the subscriber data on a valid subscriber is deleted, the calls to the subscriber fail. Such a deleted valid subscriber does not become valid until he/she moves to a degree that triggers off location update or he/she makes a call.

In another solution, the system also maintains information on the last contact between the system and a subscriber (mobile station) over the radio path. This solution uses re-registrations to prevent valid subscribers from being deleted. Depending on the system, either the subscriber's mobile station is programmed to re-register in the system at given intervals or the system asks the subscriber's mobile station to re-register at given intervals. This ensures that the activity data on accessible subscribers is updated sufficiently often. In this solution, when no contact with the subscriber (mobile station) is detected during a given time, for example two days, the system asks the subscriber to re-register. If the subscriber does not re-register within a given time, the system deletes the subscriber's data from the subscriber register. The problem in this solution is that it consumes radio path capacity, in particular,

which is often scarce, for extra (artificial) accesses over the radio path. Thus it decreases the system's call switching and registration capacity.

Furthermore, the problem in both solutions is that they require that the database of the visitor register is gone through frequently to detect any inactive subscribers. This, too, uses up system resources, decreasing call switching capacity, for example.

BRIEF DESCRIPTION OF THE INVENTION

It is thus an object of the invention to provide a method and an apparatus for implementing the method so as to solve the above problems. The objects of the invention are achieved by a method of deleting the subscriber data of an inactive mobile station from a mobile system database containing temporary subscriber data on the subscriber using the mobile station. The method comprises the following steps: maintaining in the system time data indicating the last contact with the mobile station over the radio path; paging the mobile station triggered by a factor unrelated to checking the activity of a mobile station of the mobile system; the method being characterized by, in case the mobile station does not answer the paging: calculating a first inactivity time, which is the time between the time data and the paging time; checking if the first inactivity time is equal to or longer than a predetermined time limit; and if so, deleting the subscriber data from the database.

The invention also relates to a method of marking an inactive mobile station as unreachable in a home location register containing subscriber data of a mobile system. The method comprises the following steps: maintaining in the system time data indicating the last contact with the mobile station over the radio path; paging the mobile station triggered by a factor unrelated to checking the activity of a mobile station of the mobile system, the method being characterized by, in case the mobile station does not answer the paging: calculating a first inactivity time, which is the time between the time data and the paging time; checking if the first inactivity time is equal to or longer than a predetermined time limit; and if so, marking the mobile station as unreachable.

The invention further relates to a cellular type of telecommunication network comprising at least one mobile station, at least one database for temporarily maintaining subscriber data on mobile stations. The telecommunication network is arranged to maintain time data indicating the last contact with the mobile station, and to page the mobile station triggered by a factor unre-

lated to checking the activity of a mobile station of the telecommunication network. The telecommunication network is characterized by being arranged to calculate a first inactivity time, which is the time between the time data and the paging time, in response to said failure to page the mobile station; and to delete the subscriber data from the database in response to the inactivity time being equal to or longer than a predetermined time limit.

The invention still further relates to a network node in a telecommunication system, the node being arranged to communicate with a database temporarily containing subscriber data of mobile stations of the telecommunication system, the subscriber data including time data indicating the last contact with a mobile station. The network node is arranged to page a mobile station triggered by a factor unrelated to checking the activity of a mobile station of the telecommunication system. The network node is characterized by being arranged to calculate a first inactivity time, which is the time between the time data and the paging time, in response to said failure to page the mobile station; and, in response to the inactivity time being equal to or longer than a predetermined time limit, to send to the database a command to delete the mobile station's subscriber data.

The invention is based on detecting inactive subscribers and verifying the inactivity in a way causing minimal load to the system by utilizing failed communications with the subscriber that are not intended to check the subscriber's activity over the radio path. It is an advantage of the invention that it allows the probability of deleting valid subscriber data to be minimized by attempting radio communication, without, however, consuming system capacity. Furthermore, system databases do not have to be gone through separately to detect potential inactive subscribers; instead, the subscriber data checked has already been read from a system database for example to attend to call triggering by an attempt at radio path communication. Another advantage of the invention is rapid detection of inactive subscribers who receive many calls and thus highly load the network. The invention allows the time between re-registrations to be considerably lengthened in systems where a mobile station re-registers at given intervals, resulting in less signalling at the air interface.

In the present application, the concept 'a factor unrelated to checking the activity of a mobile station' refers to other message transfer between a mobile station and the system than that transmitted in order to verify the activity of a mobile station (subscriber). In other words, it includes, not only the

message transfer detected by the subscriber, but also other message transfer, for example programming group data over the radio path from the system to a terminal. The message transfer detected by the subscriber means that someone wants either to contact the subscriber or to send information to the subscriber in a connectionless manner. In other words, a call or a message sent among signalling, e.g. a short message, is coming to the subscriber. In the present application, the term 'call' refers, not only to a conventional call, but also to other, potentially virtual, connection states in which user data is relayed, such as a data session, transmission of packet data or a mere speech item if one call is processed as separate speech items in the telecommunication system. Examples include a packet radio session (such as a GPRS session), a VoIP session (Voice IP), a multimedia session according to H.323, and speech items of the TETRA system or a corresponding system.

In a preferred embodiment of the invention, the subscriber data in a database is gone through one set of subscriber data at a time when a given condition is fulfilled and the subscriber's mobile station is requested to reregister if a predetermined time has lapsed from the previous contact. An additional advantage of this embodiment is that the method deletes the subscribers who never receive calls or messages. A further advantage of an embodiment where the condition is related to the filling of the visitor location register is that the subscriber data is gone through only when actually needed.

The preferred embodiments of the method, telecommunication network and network node of the invention are disclosed in the attached dependent claims.

BRIEF DESCRIPTION OF THE FIGURES

In the following the invention will be described in detail by means of preferred embodiments with reference to the attached drawings, in which

Figure 1 is a simplified block diagram of a telecommunication network according to a first preferred embodiment of the invention,

Figures 2 and 3 are flow diagrams of the operation of the first preferred embodiment of the invention, and

Figure 4 illustrates signalling in the first preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

In the following, the invention will be described by way of example

in a system according to the TETRA standard (TErrestrial Trunked Radio) defined by the ETSI (European Telecommunications Standards Institute), without, however, limiting the invention to any such given system. The present invention is applicable to any cellular type of mobile system, in which subscriber data is temporarily stored in a visitor location register. Such systems include for example the pan-European GSM system and its derivatives, and particularly its next generation, what is known as GSM 2+, and the third generation mobile systems being developed, the UMTS (Universal Mobile Telephone System) and the IMT-2000 (International Mobile Telecommunications 2000).

Figure 1 shows an example of the structure of a telecommunication system 1 according to the TETRA standard. Since the internal structure of the network infrastructure SwMI (Switching and Management Infrastructure) is not defined in the TETRA standard, only one exemplary solution is presented herein, and even that on a very general level. Below, network infrastructure will also be called transmission network.

Herein, a mobile station (MS) refers to the whole composed of user identification data, for example a detachably connectable identifier unit, and an actual terminal. Consequently, herein, a mobile station is directly comparable to a subscriber.

A mobile station MS communicates with a base station BS via a radio interface. Each base station BS is connected by a circuit to one of the TETRA exchanges DXT1, DXT2 (Digital Exchange for TETRA) of the fixed transmission network SwMI. The TETRA exchanges DXT1, DXT2 are connected with a fixed connection to other exchanges DXT1, DXT2 and a TETRA nodal exchange DXTc (Digital Central Exchange for TETRA), which is an exchange to which other exchanges DXT1, DXT2 and/or other nodal exchanges DXTc are connected to achieve alternative routes. The TETRA transmission network comprises open interfaces and peripherals not shown in the figure. These include for example the interface between two TETRA networks, the interface between devices connected to the network by a fixed connection and an exchange, outer interfaces to other networks, such as to the public telephone network PSTN, and network management systems and interfaces.

The system 1 also comprises as subscriber registers at least a home location register HLR and a visitor location register VLR1, VLR2. As was stated previously, the subscriber data is stored permanently or semi-permanently in the home location register HLR of the system, and temporarily in that

visitor location register VLR1 in whose area the mobile station MS is located at each particular time. In other words, the visitor location register is a database that serves the exchange serving the mobile station and temporarily contains subscriber data. Each register may be a separate network node, a register distributed to the exchanges DXT1, DXT2 or to the nodal exchanges DXTc or a register integrated into one of them in a centralized manner. The way the registers are implemented is not relevant to the invention. What is relevant is that subscriber data, required for e.g. routing, is found in the network. In the example of Figure 1, the visitor location registers VLR1, VLR2 are integrated into exchanges DXT1, DXT2, and the home location register is a separate network node connected to the nodal exchange DXTc.

The SwMI network nodes of the TETRA transmission network shown in Figure 1 are usually interconnected via a signalling network SS7. However, the invention is not limited to this kind of a network and signalling; other networks and signalling, such as the ATM or IP, can also be used.

The telecommunications system and network implementing the functionality of the present invention comprise, in addition to means required for implementing prior art services, also means for calculating the inactivity time of a mobile station and for deleting subscriber data and/or marking a subscriber as unreachable if the inactivity time is equal to or longer than a predetermined time limit. In addition, the system may comprise means for sending a re-registration request to a mobile station when a predetermined condition is fulfilled. Present network nodes comprise processors and memory, which can be utilized in the functions according to the invention. All changes needed to implement the invention can be carried out as added or updated software routines and/or with application-specific integrated circuits (ASIC).

Figures 2 and 3 are flow diagrams of the deletion of inactive subscribers' subscriber data according to a first preferred embodiment of the invention using a call as exemplary message transfer. In the first preferred embodiment of the invention, time data, i.e. information about the last contact with the subscriber, is maintained in the subscriber data of a visitor location register. In the first preferred embodiment of the invention, the subscriber data of inactive mobile stations is deleted in two steps, i.e. when paging a mobile station fails (Figure 2) or when the visitor location is being gone through one set of subscriber data at a time (Figure 3). In a preferred embodiment of the invention, only the functions shown in Figure 2 are executed. In another preferred

embodiment of the invention, the functions shown in Figure 2 are executed, and, in addition thereto, the mobile station is arranged to re-register in the network at given intervals, the interval preferably being slightly shorter than the inactivity time that causes deletion. The inactivity time will be explained later.

Referring to Figure 2, in step 201, a call set-up request is received to a mobile station. As a result, in step 202, the subscriber data of the mobile station is retrieved from a visitor location register. In step 203, the mobile station is paged in accordance with prior art. If the paging is successful (step 204), i.e. the mobile station answered the paging, the time data is updated in step 205, and call set-up is continued in step 206.

If the paging failed (step 204), i.e. the mobile station did not answer the paging, in step 207, the time data is retrieved from the subscriber data, and in step 208, the inactivity time Te1 is calculated. The inactivity time is calculated on the basis of the time data and the paging time. In other words, the inactivity time indicates the length of the time between the previous contact and the performed, failed paging. Then, in step 209, a check is made to see if the inactivity time Te1 is less than a predetermined time limit time1, e.g. 6 hours. If the inactivity time is less than the time limit, the process continues in accordance with prior art, i.e. because the paging failed, in step 210, the call set-up request is replied by indicating that the mobile station cannot be reached.

If the inactivity time is equal to or longer than the time limit (step 209), in step 211, the subscriber data of the mobile station is deleted from the visitor location register; in step 212, an instruction is sent to the home location register to mark the subscriber as unreachable, whereupon in step 210, the call set-up request is replied by indicating that the mobile station cannot be reached because the paging failed.

Figure 3 shows the process according to the first preferred embodiment of the invention, executed as background processing in the system. Step 301 in Figure 3 monitors if the condition is fulfilled. The condition may be associated for example with the fullness of the visitor location register, i.e. does the subscriber data of inactive mobile stations take up space from other mobile station subscribers. The condition may also be associated with time, i.e. to ensure that the subscriber data in the visitor location register is gone through always at given intervals. The interval may be long since no attempts have been made to contact the inactive mobile stations found in this way, and

the subscriber data does not harm the system, except if the visitor location register is filled up. Any other suitable condition or a combination of several conditions may also be used.

When the condition is fulfilled (step 301), in step 302, the subscriber data of a first mobile station is retrieved, and the time data is retrieved from that data in step 303. In step 304, the inactivity time Te2 is calculated on the basis of the time data and the data retrieval time. In other words, the inactivity time indicates how much time has lapsed from the previous contact. Then, in step 305, a check is made to see if the inactivity time Te2 is less than a predetermined time limit time2. The time limit time2 may be the same as the time limit time1 used in the comparison of Figure 2, but it may also be different. If the inactivity time Te2 is less than the time limit, step 306 checks if the subscriber data of the mobile station is the last subscriber data in the visitor location register. In other words, in step 306, a check is made to see if all data has been gone through. If all subscriber data has been gone through, the process returns to step 301 to monitor the fulfilment of the condition. If there is still subscriber data to be gone through (step 306), in step 307, the subscriber data of the following mobile station is retrieved and the process moves to step 303 to retrieve the time data from the subscriber data.

If the inactivity time is equal to or longer than the time limit (step 305), in step 308, a re-registration request is sent to the mobile station, and in step 309, the process waits a given time for the mobile station to register. If the mobile station registers (step 310), the time data is updated in step 311, and the process continues to step 306 to check if all data has been gone through. If the mobile station does not register within said given time (step 310), in step 312, the subscriber data of the mobile station is deleted from the visitor location register, and in step 313, an instruction is sent to the home location register to mark the mobile station as unreachable, whereupon the process moves to step 306 to check if all data has been gone through.

In a preferred embodiment of the invention, the condition is associated with the degree of fullness of the visitor location register, i.e. the total amount of subscriber data in the register, and a check can be made before step 306 to see if the visitor location register is sufficiently empty, and if so, the paging and deletion of inactive mobile stations can be stopped. In other words, in this embodiment, only a necessary amount of data is deleted by re-registrations consuming radio path capacity. When the condition is fulfilled the next

time, this embodiment allows the emptying of the visitor register to be continued from that point where the process stopped the previous time.

The steps described above in Figures 2 and 3 are not in absolute chronological order, and some points can be executed simultaneously or deviating from the order presented. The conditions associated with comparing the inactivity time may also be different from what was described above. Other functions may also be executed between the steps, associated with connection establishment or failure thereof and/or maintaining subscriber data. Some steps may also be omitted, such as step 306 in Figure 3 in such an embodiment where the visitor location register goes through the subscriber data until there is sufficiently free memory in the visitor location register.

Figure 4 shows signalling according to the first preferred embodiment of the invention using a call as an example of message transfer. The assumption in Figure 4 is that the mobile station does not respond to the paging and the time limit set for the inactivity is exceeded. The messages between the mobile station MS, the exchange DXT, the visitor location register VLR and the home location register HLR are for example messages of the signalling system SS7 adapted to TETRA. If the VLR is integrated into the exchange DXT, intra-nodal data transmission is concerned. However, the invention is not restricted to these messages and this protocol, but other protocols and messages may also be used to transmit the same data. The data is most preferably transmitted by standard messages.

Referring to Figure 4, in step 4-1, the exchange DXT receives a call set-up request for a mobile station MS. In order to page the mobile station, the exchange DXT requests for subscriber data of the mobile station MS from the visitor location register VLR in a message 4-2. The visitor location register retrieves the subscriber data and sends it to the exchange DXT in a message 4-3. Having received the subscriber data, the exchange DXT pages the mobile station with messages 4-4. In step 4-5, the exchange notes that paging the mobile station MS failed, since the mobile station does not answer. The exchange DXT therefore retrieves (4-5) time data from the subscriber data, i.e. the point of time of the last contact with the mobile station, and uses it to calculate (step 4-5) the inactivity time Te1 and checks (step 4-5) if it exceeds the time limit time1. Since, in the example of Figure 4, the time limit time1 is exceeded (step 4-5), the exchange DXT sends to the visitor location register VLR an instruction in a message 4-6 to delete the subscriber data of the mo-

bile station. Having received the message, the VLR deletes the subscriber data of the mobile station in step 4-7. The exchange DXT also sends to the home location register HLR in a message 4-8 an instruction to mark the mobile station as unreachable. Having received the message, the HLR marks the mobile station as unreachable in step 4-9. The exchange DXT also replies the call set-up request stating that the mobile station is unreachable (not shown in Figure 4).

The messages 4-6 and 4-8 are preferably the same messages as are used when a mobile station unregisters from the network.

The signalling messages described above in association with Figure 4 are only suggestive and may contain several separate messages for transmitting the same information. Other messages, associated for example with call set-up, may also be sent among the messages. Furthermore, the messages may contain other information. Depending on the operators and the system, other network elements, to which different functionalities are distributed, may also participate in data transmission and signalling.

Although in the above the operation of the first preferred embodiment of the invention was described by means of a call, it is obvious to a person skilled in the art how to apply the invention to a failure of delivering messages transmitted between signalling and to a failure of message transfer not perceived by the subscriber.

Although the above presents the invention assuming that the network comprises visitor and home location registers, it is obvious to a person skilled in the art how to apply the invention to a network only comprising a home location register. In this case, subscriber data is not deleted at all, but the subscriber is only marked as unreachable.

It is to be understood that the above description and the related figures are only intended to illustrate the present invention. Different variations and modifications of the invention are obvious to persons skilled in the art, without deviating from the scope of the invention disclosed in the attached claims.

CLAIMS

1. A method of deleting the subscriber data of an inactive mobile station from a mobile system database containing temporary subscriber data on the subscriber using the mobile station, the method comprising the following steps:

maintaining (205) in the system time data indicating the last contact with the mobile station over the radio path;

paging (203) the mobile station triggered by a factor unrelated to checking the activity of a mobile station of the mobile system;

characterized by, in case the mobile station does not answer the paging:

calculating (208) a first inactivity time, which is the time between the time data and the paging time;

checking (209) if the first inactivity time is equal to or longer than a predetermined time limit; and

if so, deleting (211) the subscriber data from the database.

2. A method as claimed in claim 1, **characterized** by the further steps of:

monitoring (301) the fulfilment of a predetermined condition in the system;

going through the subscriber data in the database in response to the fulfilment of the condition, the going through comprising the steps of:

a) retrieving (302, 307) the subscriber data;

b) calculating (304) a second inactivity time, which is the time between data retrieval and the time data;

c) checking (305) if the second inactivity time is equal to or longer than the predetermined time limit; and

d) if so, sending (308) a re-registration request to the mobile station; and

d1) in response to the mobile station's re-registration, updating (311) the time data to correspond to the re-registration time;

d2) in response to the mobile station not re-registering within a given time, deleting (312) the subscriber's subscriber data from the database.

3. A method as claimed in claim 2, **characterized** by the condition being associated with the total amount of subscriber data in the da-

tabase.

4. A method as claimed in claim 2, **characterized** by the condition being associated with the time lapsed from the previous going through of the database.

5. A method of marking an inactive mobile station as unreachable in a home location register containing subscriber data of a mobile system, the method comprising the following steps:

maintaining in the system time data indicating the last contact with the mobile station over the radio path;

paging (203) the mobile station triggered by a factor unrelated to checking the activity of a mobile station of the mobile system;

characterized by, in case the mobile station does not answer the paging,

calculating (208) a first inactivity time, which is the time between the time data and the paging time;

checking (209) if the first inactivity time is equal to or longer than a predetermined time limit; and

if so, marking the mobile station as unreachable.

6. A cellular type of telecommunication network (SwMI) comprising at least one mobile station (MS),

at least one database (VLR1, VLR2) for temporarily maintaining subscriber data of mobile stations, and

the telecommunication network (SwMI) being arranged to maintain time data indicating the last contact with the mobile station (MS), and to page the mobile station (MS) triggered by a factor unrelated to checking the activity of a mobile station of the telecommunication network;

characterized in that

the telecommunication network (SwMI) is arranged to calculate a first inactivity time, which is the time between the time data and the paging time, in response to said failure to page said mobile station (MS); and to delete the subscriber data from the database (VLR1, VLR2) in response to the inactivity time being equal to or longer than a predetermined time limit.

7. A telecommunication network (SwMI) as claimed in claim 6, **characterized** in that the network (SwMI) is further arranged to retrieve subscriber data from the database (VLR1, VLR2) in response to the fulfilment of a predetermined condition; calculate a second inactivity time for the mobile

station (MS), which is the time between data retrieval and the time data; check if the second inactivity time is equal to or longer than the predetermined time limit; and, if so, send a re-registration request to the mobile station (MS); update the time data in response to re-registration by the mobile station (MS); and in response to the mobile station (MS) not re-registering within a given time, delete the subscriber's subscriber data from the database (VLR1, VLR2).

8. A telecommunication network (SwMI) as claimed in claim 7, **characterized** in that the condition is associated with the total amount of subscriber data in the database (VLR1, VLR2).

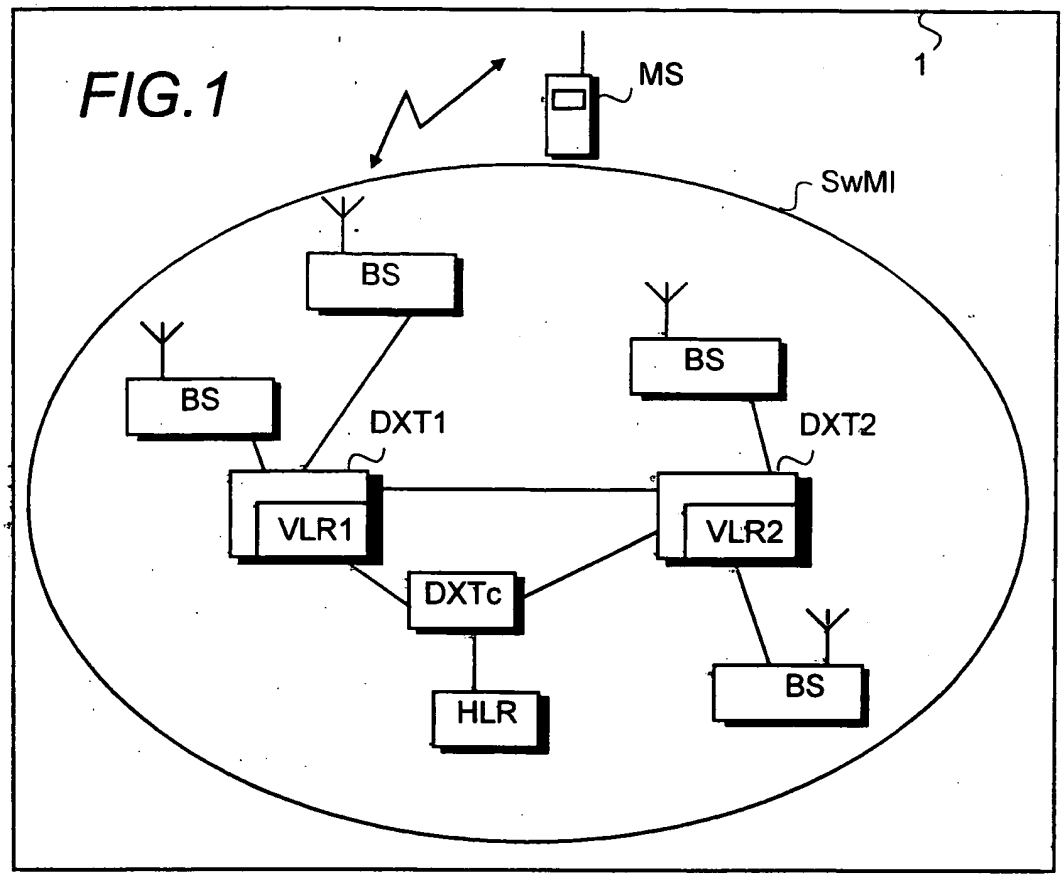
9. A telecommunication network (SwMI) as claimed in claim 7, **characterized** in that the condition is associated with time.

10. A network node (DXT1, DXT2) in a telecommunication system, the node being arranged to communicate with a database temporarily containing subscriber data of mobile stations of the telecommunication system, the subscriber data including time data indicating the last contact with a mobile station, and the network node being arranged to page a mobile station triggered by a factor unrelated to checking the activity of a mobile station of the telecommunication system,

characterized in that the network node (DXT1, DXT2) is arranged to calculate a first inactivity time, which is the time between the time data and the paging time, in response to said failure to page the mobile station; and, in response to the inactivity time being equal to or longer than a predetermined time limit, to send to the database a command to delete the mobile station's subscriber data.

11. A network node (DXT1, DXT2) as claimed in claim 10, **characterized** in that the network node (DXT1, DXT2) is further arranged to retrieve subscriber data from the database in response to the fulfilment of a predetermined condition; calculate a second inactivity time for the mobile station, which is the time between data retrieval and the time data; check if the second inactivity time is equal to or longer than the predetermined time limit; and, if so, send a re-registration request to the mobile station; update the time data in response to a re-registration by the mobile station; and in response to the mobile station not re-registering within a given time, delete the subscriber's subscriber data from the database.

FIG.1


1
MS
SwMI
BS
BS
BS
DXT1
DXT2
VLR1
VLR2
DXTc
HLR
BS

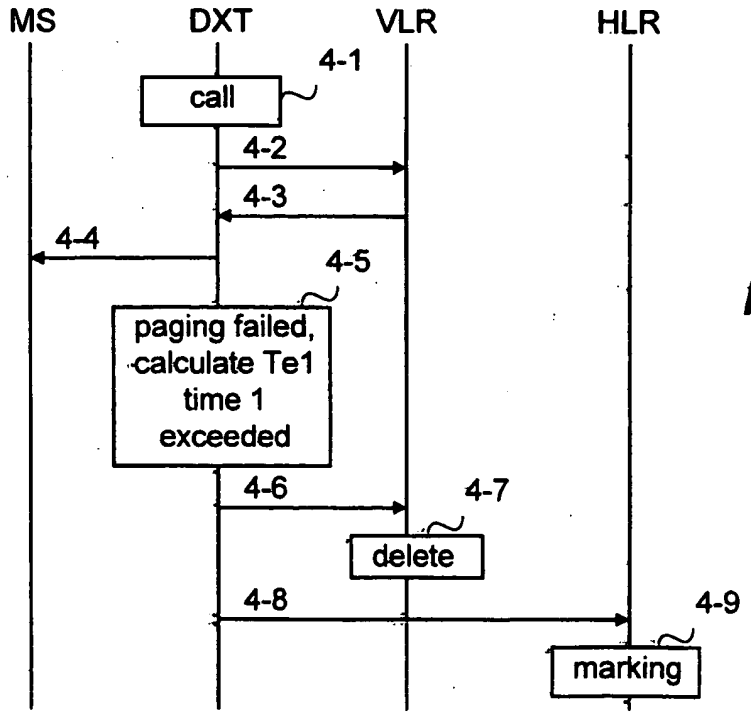

MS
DXT
VLR
HLR
4-1
call
4-2
4-3
4-4
4-5
paging failed, calculate Te1 time 1 exceeded
4-6
4-7
delete
4-8
4-9
marking

FIG.4

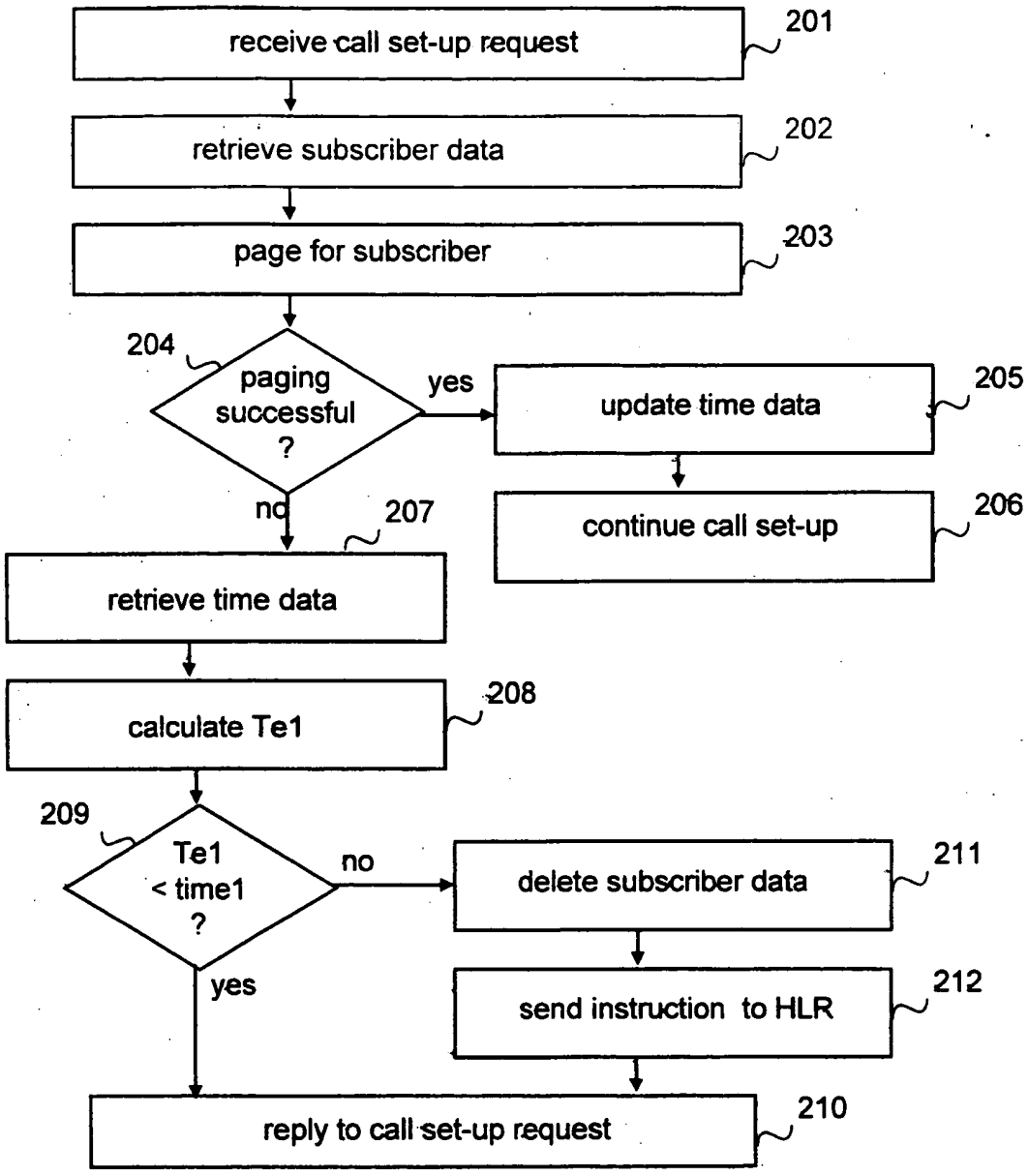

receive call set-up request
201
retrieve subscriber data
202
page for subscriber
203
204
paging successful ?
yes
update time data
205
continue call set-up
206
no
207
retrieve time data
calculate Te1
208
209
Te1 < time1 ?
no
delete subscriber data
211
send instruction to HLR
212
yes
reply to call set-up request
210

FIG.2

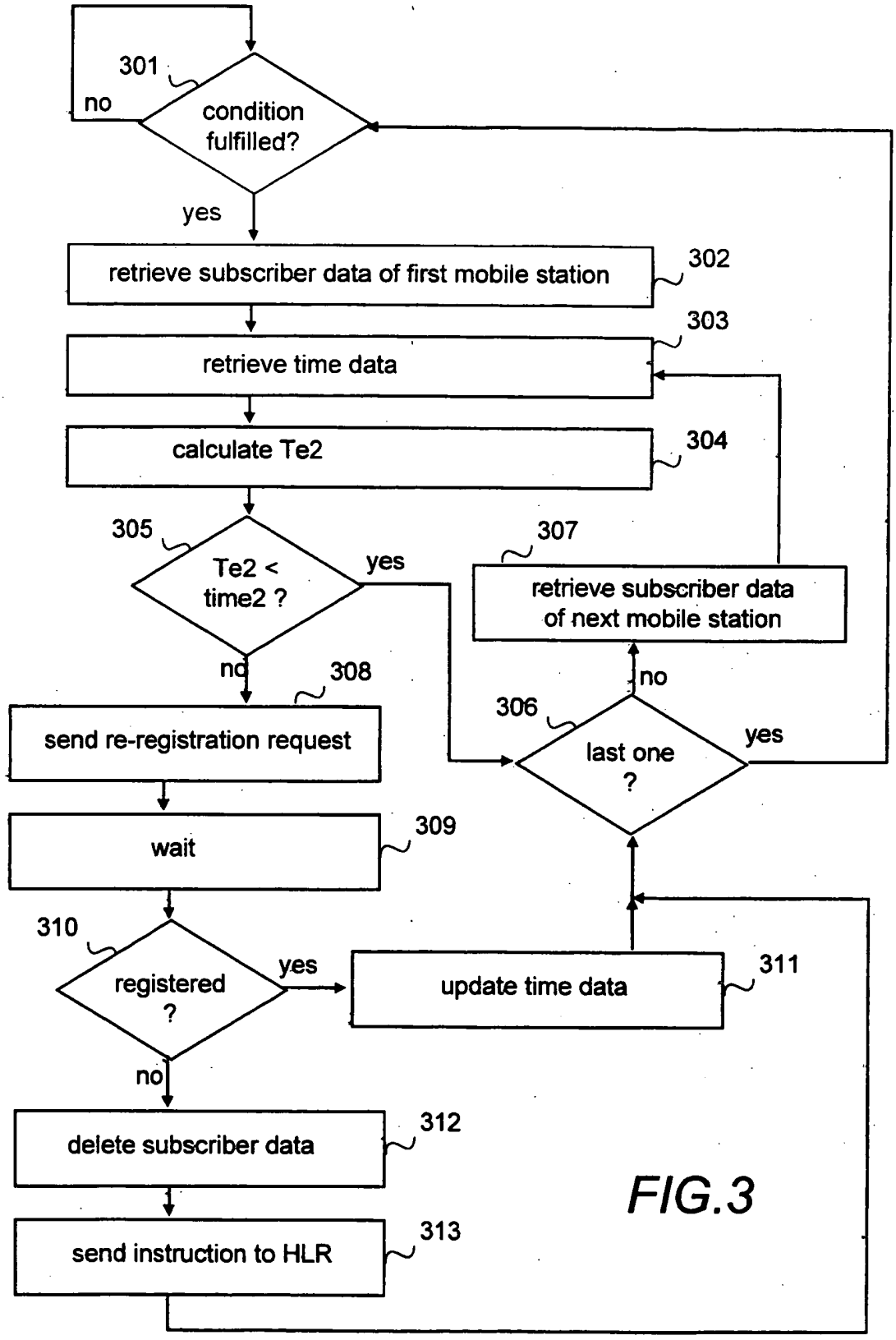

301
condition fulfilled?
no
yes
retrieve subscriber data of first mobile station
302
retrieve time data
303
calculate Te2
304
305
Te2 < time2 ?
yes
no
307
retrieve subscriber data of next mobile station
308
send re-registration request
306
last one ?
yes
no
wait
309
310
registered ?
yes
no
update time data
311
delete subscriber data
312
send instruction to HLR
313

FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00927

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/32
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	EP 969685 A2 (NEC CORPORATION), 5 January 2000 (05.01.00), column 4, line 51 - column 5, line 47, abstract --	1-11
A	EP 0838963 A2 (SIEMENS AKTIENGESELLSCHAFT), 29 April 1998 (29.04.98), claim 1, abstract --	1,5,6,10
A	WO 9629838 A1 (NOKIA TELECOMMUNICATIONS OY), 26 Sept 1996 (26.09.96), abstract -- --------	1,5,6,10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 February 2001	27-02-2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Jaana Raivio/js Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/FI 00/00927

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 969685 A2	05/01/00	NONE	
EP 0838963 A2	29/04/98	CN 1180978 A	06/05/98
		DE 19644140 C	10/06/98
WO 9629838 A1	26/09/96	AU 705282 B	20/05/99
		AU 4946296 A	08/10/96
		BR 9605939 A	12/08/97
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		EP 0760195 A	05/03/97
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		NZ 303221 A	25/03/98
		US 5901353 A	04/05/99